REMARKS

Applicants acknowledge receipt of the Office Action dated February 27, 2003. In that action, the Examiner: 1) entered a restriction requirement between Group I (claims 1-11 and 21-28) and Group II (claims 12-20); 2) rejected claims 1, 8, 9 and 27 as allegedly indefinite; 3) rejected claims 1-11 as allegedly anticipated by *Kimball* (U.S. Patent No. 5,449,560); and 4) rejected claims 21-28 as allegedly unpatentable over *Kimball*.

With this Office Action Response, Applicants amend claims 1, 3, 8, 9 and 27, and withdraw claims 12-20 (in response to the restriction requirement). Applicants believe the pending claims are allowable over the art of record and respectfully request reconsideration.

I. RESTRICTION REQUIREMENT.

Applicants have elected to prosecute the group designated by the Examiner as Group I, Claims 1-11 and 21-28. Applicants respectfully traverse this restriction requirement.

The Manual of Patent Examining Procedures (MPEP) states:

> If the search and examination of an entire application can be made without serious burden, the examiner must examine it on the merits, even though it includes claims to independent or distinct inventions.

MPEP, Section 803. Applicants respectfully submit that there will be no additional burden on the Examiner to examine the entire application. For example, claim 4 (in Group I) requires:

> creating a correlation matrix... ;
> determining eigenvectors and eigenvalues of the correlation matrix ...;
> removing a higher order eigenvector to create a subspace... ;

Claim 4. Claim 12 (in Group II) requires:

> calculating a correlation matrix ... ;
> determining eigenvectors and corresponding eigenvalues of the correlation matrix;
> removing at least one eigenvector to create an incomplete basis;

Claim 12. Thus, the Examiner, in examining the Group I claims, will need to search for art relating to calculation the correlation matrix, determining eigenvectors and eigenvalues of the correlation matrix, and removing at least one eigenvector. This search, by its very nature, overlaps with the search that may be required for the non-elected Group II.

Based on the foregoing, Applicants respectfully submit that while there may be separate inventions between the elected and non-elected groups, there will be no serious additional burden to examine the case in its entirety.

II. AMENDMENTS TO THE SPECIFICATION

With this Office Action, Applicants amend the specification, in particular paragraph [0032]. Applicants respectfully submit that this amendment is merely to correct a grammatical error, and therefore presents no new matter.

III. SECTION 112 REJECTIONS

In the Office Action dated February 27, 2003, the Examiner rejected claims 1, 8-9 and 27 as allegedly indefinite. In particular, the Examiner alleged that "a plurality of component functions" may not be clear. With this Office Action Response, Applicants have amended claim 1 to require "finding a plurality of component functions that define an orthogonal basis of the correlation matrix … ." Applicants respectfully submit that this rearranging of the terms of the claim should now make more clear that the component functions are used to define an orthogonal basis. Applicants respectfully submit that this is not a narrowing amendment which would give rise to *Festo*-type inquiries.

Still with regard to claim 1, the Examiner alleges that it is not clear as to the nature of a "subspace." With regard to "subspace," the following statements are made in the specification, page 7:

All the eigenvectors taken together form an orthogonal basis or space. Preferably, however, one or more of the higher order eigenvectors are removed **with the remaining eigenvectors becoming an incomplete basis or subspace**.

Specification, page 7, paragraph [0027] (emphasis added). It is clear from the specification that a subspace is an orthogonal basis having one or more of its component functions (such as eigenvectors and corresponding eigenvalues) removed. Based on the foregoing, Applicants respectfully submit that, in light of the specification, the term "subspace" is not indefinite.

With respect to claims 8 and 27, the Examiner alleged that it is not clear what the delineated equations equal. To address the Examiner's concerns, Applicants have amended claim 8 to make more clear that the objective function value is calculated using the delineated equation. A similar amendment has been made with respect to claim 27. Applicants respectfully submit that these amendments are not narrowing amendments which would give rise to *Festo*-type inquiries.

Finally, Applicants have corrected equation in claim 9 as requested by the Examiner. Again, however, this amendment to claim 9 is not a narrowing amendment.

Based on the foregoing, Applicants respectfully submit that all the Examiner's Section 112 rejections have been addressed.

IV. SECTION 102 AND SECTION 103 REJECTIONS

A. Claim 1

Claim 1, as amended, is directed to a method comprising converting the time domain representation of acoustic energy received by a plurality of receivers into frequency domain representations, creating a correlation matrix from amplitudes within the frequency domain representations at corresponding frequencies, finding a plurality of component functions that define an orthogonal basis of the correlation matrix, removing at least one of the component functions to

create a subspace, and multiplying a test vector and the subspace (the test vector based on an estimated acoustic velocity of the earth formation) to determine whether the estimated acoustic velocity substantially matches the actual earth formation acoustic velocity. The Examiner rejected claim 1 as allegedly anticipated by *Kimball*. Applicants amended claim 1 with respect to the Examiner's Section 112 rejections, and not to define over *Kimball*.

"[F]or anticipation under 35 U.S.C. 102, the reference must teach every aspect of the claimed invention, either explicitly or impliedly. Any feature not directly taught must be inherently present." MPEP 706.02. Applicants respectfully submit that *Kimball* does not teach or render obvious all the limitations of claim 1.

Kimball may define a plurality of **model** orthonormal basis U^k for each wave type expected to exist in a particular system (compressional, shear, Stonley) – **model space**. *Kimball*, Col. 6, lines 60-62; *see* Col. 10, lines 27-31. In order to ease the computational burden with respect to using the model orthonormal basis, lower order eigenvectors and eigenvalues may be removed. *See Kimball* Col. 9, lines 38-48.

> $\bar{a}^k$ can be approximated by the first r_k eigenvectors of U^k. These eigenvectors form
> an orthonormal basis for an approximate version [of the eigenvectors] given
> filtering and windowing operations.

Kimball, Col. 7, lines 59-62. Thus, while *Kimball* may discuss an orthonormal basis, this basis is part of a model.

By contrast, claim 1 specifically requires creating a correlation matrix from amplitudes within the frequency domain representations of the acoustic energy as it traverses the earth formation, finding an orthogonal basis of the correlation matrix, and removing at least one component function to create a subspace. Clearly, claim 1 is directed to removing components of a

basis representing received data -- **the data space**. *Kimball* and claim 1 operate in totally different spaces. Thus, *Kimball* does not teach, or inherently contain, all the limitations of claim 1.

Based on the foregoing, Applicants respectfully submit that claim 1, and all claims which depend from claim 1 (claims 2-11), should be allowed.

B.   Claim 4

Claim 4 is dependent from claims 1 and 3 and has all the limitations of those claims, and further requires that removing a component function to create a subspace further comprises removing a higher order eigenvector corresponding to received acoustic energy related to the acoustic energy created by the transmitter. The Examiner rejected claim 4 as allegedly anticipated by *Kimball*.

Applicants respectfully submit that *Kimball* does not teach or render obvious all the limitations of claim 4. As was discussed with respect to claim 1, *Kimball* discusses creating eigenvectors and eigenvalues in the **model space**. Claim 4, by contrast, specifically requires operations on eigenvectors related to received acoustic energy -- **data space**.

Moreover, *Kimball* teaches removing the **lower order eigenvectors and eigenvalues** by teaching that the approximation of a^k can be made using the first r_k eigenvectors of U^k. *Kimball*, Col. 7, lines 59-62. Claim 4, by contrast, teaches **removing higher order eigenvectors and eigenvalues** from the data space. Because *Kimball* operates in model space (as opposed to data space in claim 4), and further *Kimball* teaches removal of lower order eigenvectors and eigenvalues (as opposed to removal of higher order eigenvectors and eigenvalues in claim 4), *Kimball* does not teach, inherently contain, or render obvious the limitations of claim 4.

Applicants further submit that the modification suggested is not proper. "If the proposed modification or combination of the prior art would change the principle of operation of the prior art

invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious." MPEP 2143.01; *In re Ratti*, 270 F.2d 810, 123 USPQ 349 (CCPA 1959). The modification proposed changes the principle of operation of *Kimball*. In particular, *Kimball* operates in the model space, and removes lower order eigenvectors and eigenvalues of the model. To suggest that *Kimball* could be modified to operate in the data space, and to further suggest that *Kimball* could be modified to remove higher order eigenvectors and eigenvalues, changes the entire principle of operation of *Kimball*. Because the modifications suggested change the principle of operation, the rejections utilizing *Kimball* do not make a prima facie case.

Claim 4 is dependent from claims 1 and 3 and is allowable for at least the same reasons, as well as the additional limitations regarding which of the eigenvectors and eigenvalues should be removed. Thus, claim 4, and all claims which depend from claim 4 (claim 5), should be allowed.

C. Claim 21

Claim 21 is directed to a method of determining acoustic velocity and frequency dispersion of an earth formation using an acoustic tool. The method comprises sending acoustic energy into the earth formation from the acoustic tool, detecting the acoustic energy in the earth formation of the plurality of receiver locations on the acoustic tool, creating time series representations of the acoustic energy in the earth formation for each of the plurality of receiver locations, Fourier transforming each of the time series representations to create a plurality of frequency domain representations, creating a vector from values at a selected frequency in each of the plurality of frequency domain representations, creating a correlation matrix from the vector, determining the eigenvectors and eigenvalues of the correlation matrix, removing at least one of the eigenvectors thereby creating a subspace, determining a value that is indicative of the extent a test vector may be

represented by the subspace (when the test vector is based on an estimated acoustic velocity of the earth formation), plotting the value as a function of the estimated acoustic velocity of the earth formation and the selected frequency. The Examiner rejected claim 21 as allegedly obvious over *Kimball*.

Kimball may define a plurality of **model** orthonormal basis U^k for each wave type expected to exist in a particular system (compressional, shear, Stonley) – **model space**. *Kimball*, Col. 6, lines 60-62; *see* Col. 10, lines 27-31. In order to ease the computational burden with respect to using the model orthonormal basis, lower order eigenvectors and eigenvalues may be removed. *See Kimball* Col. 9, lines 38-48.

By contrast, claim 21 specifically requires creating a correlation matrix from amplitudes within the frequency domain representations of the acoustic energy as it traverses the earth formation, finding an orthogonal basis of the correlation matrix, and removing at least one component function to create a subspace. Thus, claim 21 is directed to removing components of a basis representing received data -- **the data space**. *Kimball* and claim 21 operate in totally different spaces. Thus, *Kimball* does not teach or render obvious all the limitations of claim 21.

Based on the foregoing, Applicants respectfully submit that claim 21, and all claims which depend from claim 21 (claims 22-28), should be allowed.

D.   Claim 25

Claim 25 is directed to a method of determining acoustic velocity and frequency dispersion of an earth formation having all the limitations of claim 21, and further requiring removing at least one higher order eigenvector, the removed at least one higher order eigenvector corresponding to desired acoustic signals, and the remaining eigenvectors corresponding to noise. The Examiner rejected claim 25 as allegedly obvious over *Kimball*.

Applicants respectfully submit that *Kimball* does not teach or render obvious all the limitations of claim 25. As was discussed with respect to claim 21, *Kimball* discusses performing creating eigenvectors and eigenvalues in the model space. Claim 21, by contrast, specifically requires operations on eigenvectors related to received acoustic energy -- the data space.

Moreover, *Kimball* teaches removing the **lower order eigenvectors and eigenvalues** by teaching that the approximation of a^k can be made using the first r_k eigenvectors of U^k. *Kimball*, Col. 7, lines 59-60. Claim 25, by contrast, teaches removing higher order eigenvectors and eigenvalues from the data space. Because *Kimball* operates in model space (as opposed to data space in claim 25), and further *Kimball* teaches removal of lower order eigenvectors and eigenvalues (as opposed to removal of higher order eigenvectors and eigenvalues in claim 25), *Kimball* does not teach, inherently contain, or render obvious the limitations of claim 4.

Applicants further submit that the modification suggested is not proper. "If the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious." MPEP 2143.01; *In re Ratti*, 270 F.2d 810, 123 USPQ 349 (CCPA 1959). The modification proposed changes the principle of operation of *Kimball*. In particular, *Kimball* operates in the model space, and removes lower order eigenvectors and eigenvalues of the model. To suggest that *Kimball* could be modified to operate in the data space, and to further suggest that *Kimball* could be modified to remove higher order eigenvectors and eigenvalues, changes the entire principle of operation of *Kimball*. Because the modifications suggested change the principle of operation, the rejections utilizing *Kimball* do not make a prima facie case.

Based on the foregoing, Applicants respectfully submit that claim 25, and all claims which depend from claim 25 (claims 26-28), should be allowed.
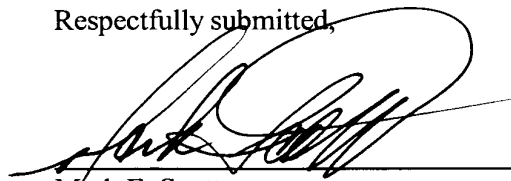
V.   CONCLUSION

Applicants respectfully request reconsideration and allowance of the pending claims. If the Examiner feels that a telephone conference would expedite the resolution of this case, he is respectfully requested to contact the undersigned.

In the course of the foregoing discussions, Applicants may have at times referred to claim limitations in shorthand fashion, or may have focused on a particular claim element. This discussion should not be interpreted to mean that the other limitations can be ignored or dismissed. The claims must be viewed as a whole, and each limitation of the claims must be considered when determining the patentability of the claims. Moreover, it should be understood that there may be other distinctions between the claims and the prior art which have yet to be raised, but which may be raised in the future.

If any fees are inadvertently omitted or if any additional fees are required or have been overpaid, please appropriately charge or credit those fees to Conley Rose, P.C. Deposit Account Number 03-2769/1391-26700.

Respectfully submitted,

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